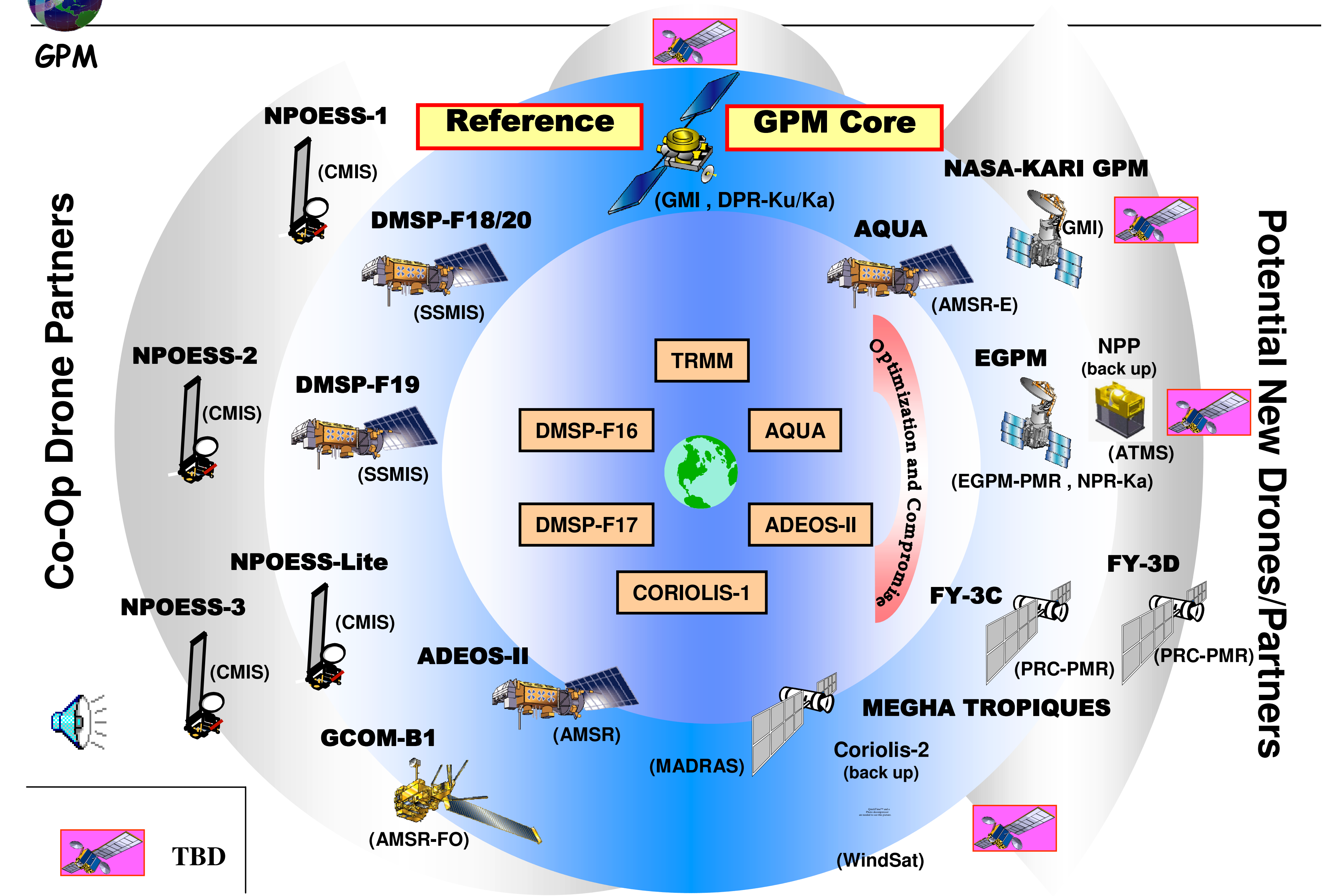
Notional International Constellation Architecture



GPM

Potential GPM Validation Sites

Supersite   Regional Raingage Site   Supersite & Regional Raingage Site

GPM Validation Strategy

GPM

Research Quality Data

Confidence
sanity checks

I. Basic Rainfall Validation
•Raingauges/Radars
new/existing gauge networks
new/existing radar networks

II. GPM Supersites
• Basic Rainfall Validation
hi-lo res gauge/disdrometer networks
polarametric Radar system

• Accurate Physical Validation
scientists & technicians staff
data acquisition & computer facility
meteorological sensor system
upfacing multifreq radiometer system
D_o/DSD variability/vertical structure
convective/stratiform partitioning

Calibration

Continuous Synthesis
•error variances
•precip trends

Supersite Products

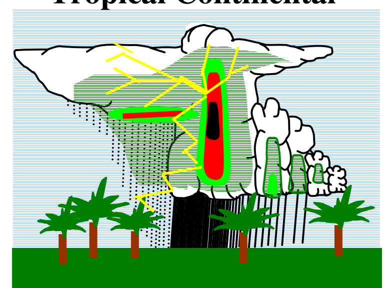
Algorithm Improvements

Research
•cloud macrophysics
•cloud microphysics
•cloud-radiation modeling

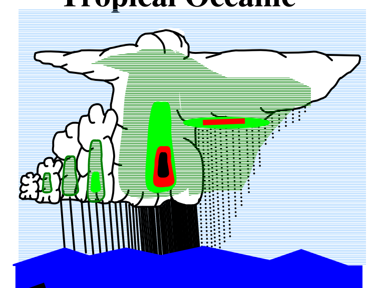
FC Data

III. GPM Field Campaigns
• GPM Supersites
cloud/ precip/radiation/dynamics processes
• GPM Alg Problem/Bias Regions
targeted to specific problems

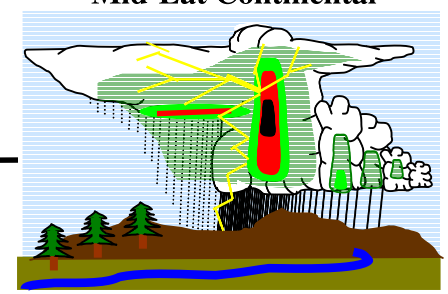
Tropical Continental



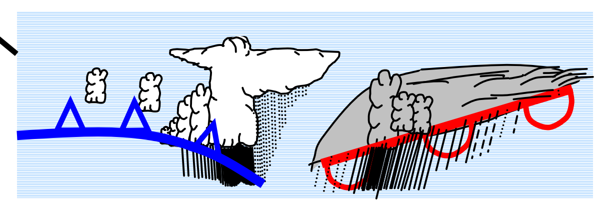
Tropical Oceanic



Mid-Lat Continental



Extratropical Baroclinic

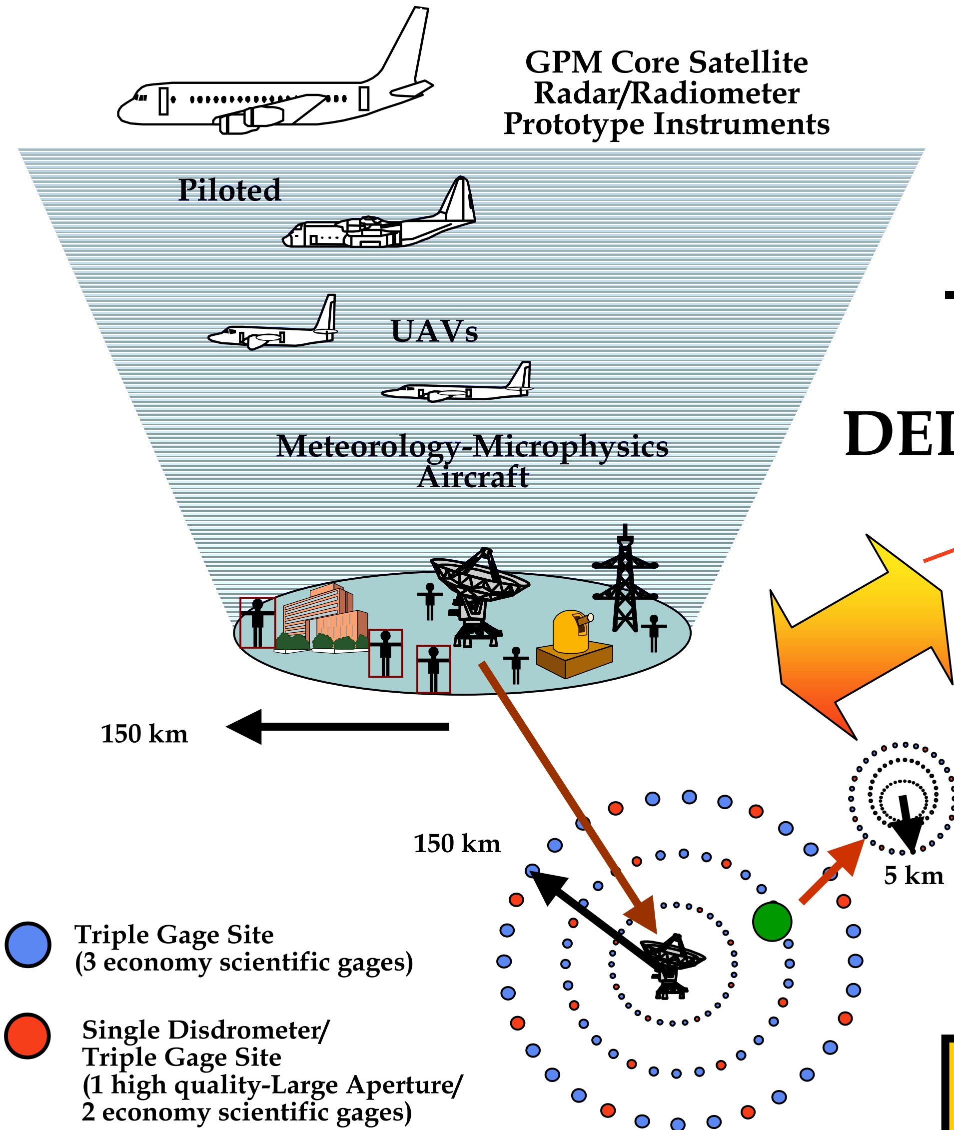


High Latitude Snow

Supersite Template

GPM

Focused Field Campaigns



Legend

- Data Acquisition-Analysis Facility
- Multiparameter Radar
- Uplk Mtchd Radiom/Radar
S-/X-Band Profilers
90 GHz Cloud Radar
- Meteorological Tower & Sounding System
- Site Scientist (3)
- Technician (3)

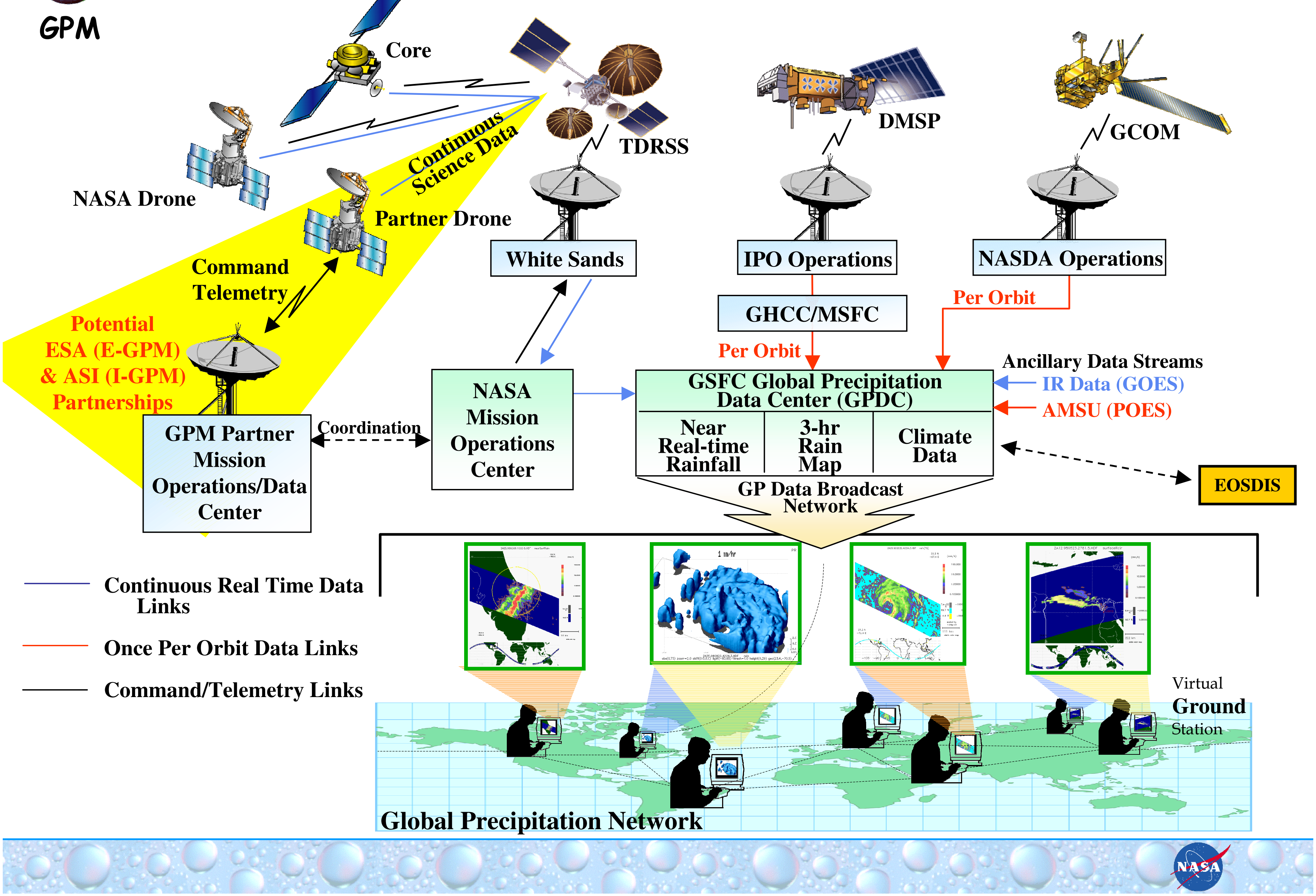
DELIVERY

- Retrieval Error Synthesis
- Algorithm Improvement Guidance
- Validation Analysis

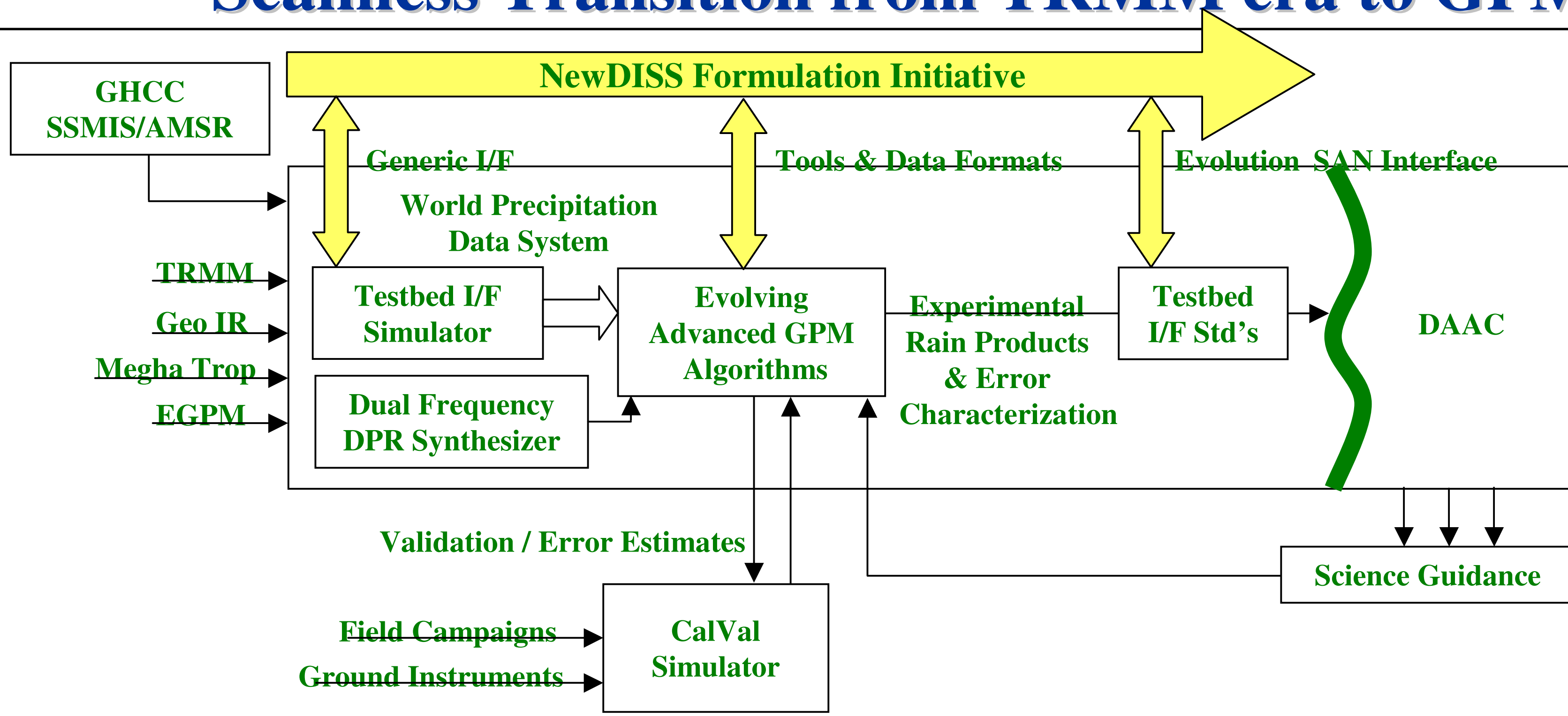
50-Gage Site Hi-Res Domain Center-Displaced with
- Uplooking Matched Radiom/Radar
[10.7,19,22,37,85,150 GHz/14,35 GHz]
- Upward S-/X-band Doppler Radar Profilers & 90 GHz Cloud Radar

100-Gage Site Lo-Res Domain Centered on Multi-parm Radar

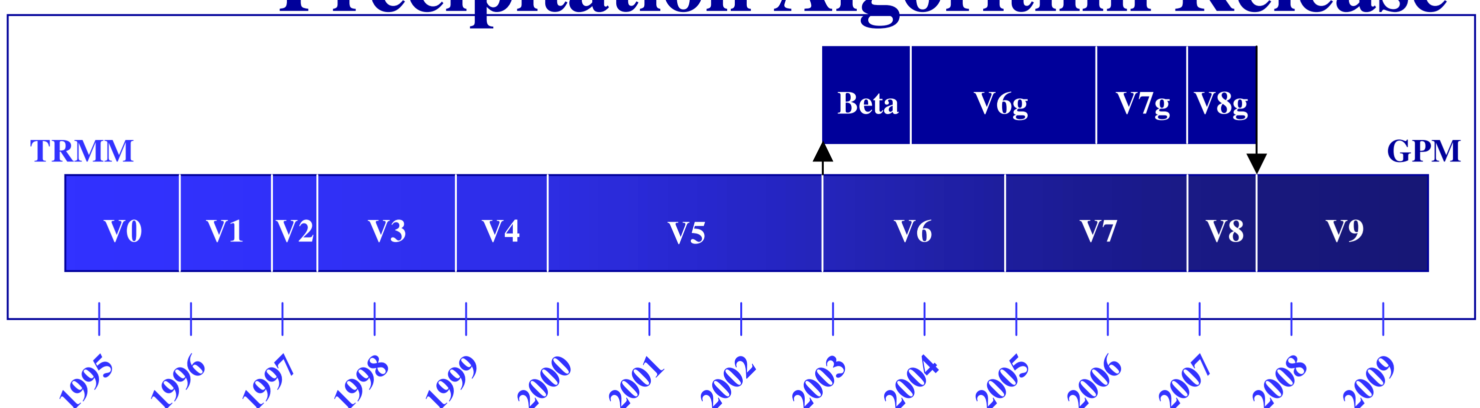
GPM Operations & Data Flow



Seamless Transition from TRMM era to GPM



Precipitation Algorithm Release



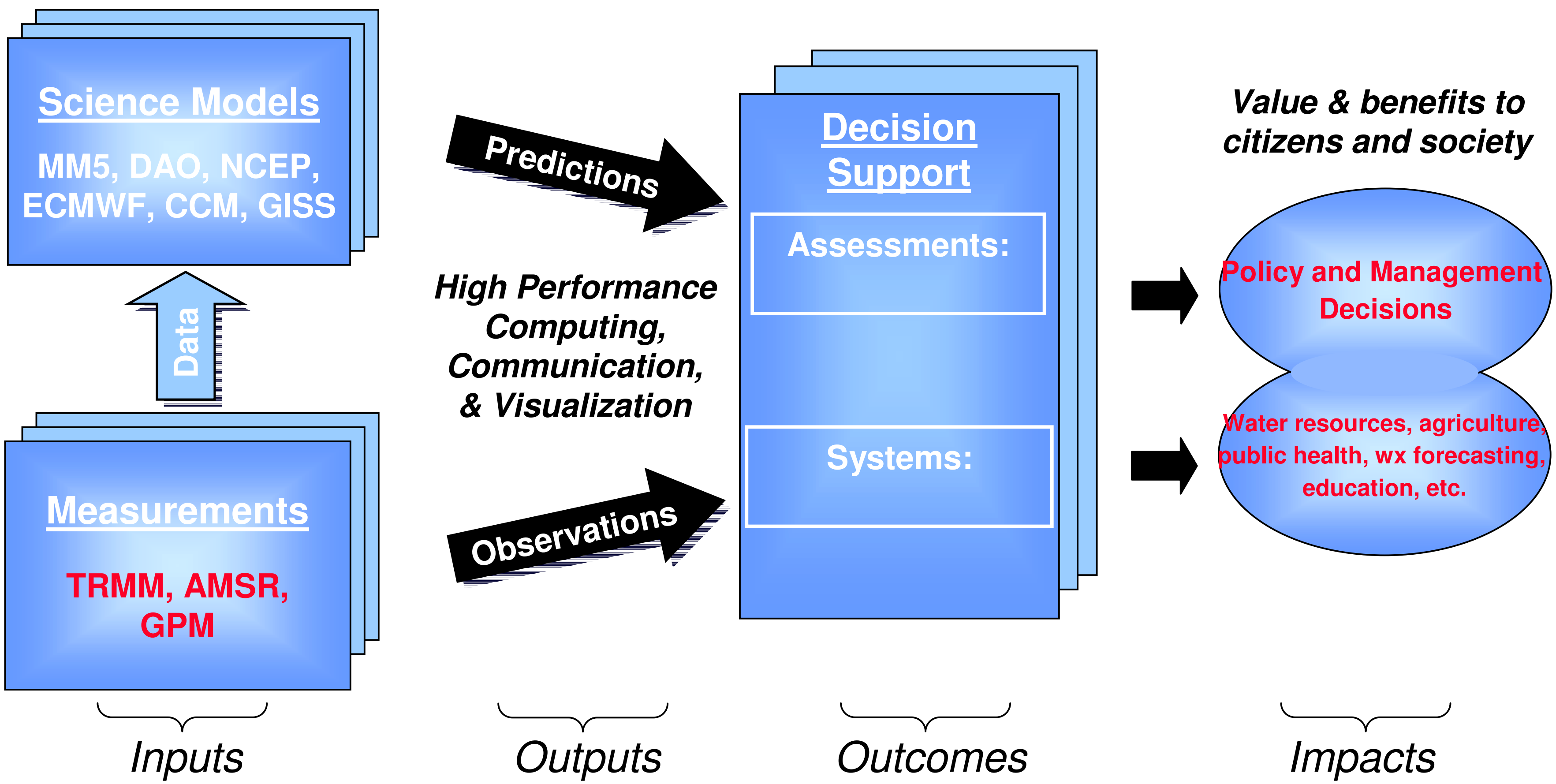
GPM

In addition to Science Requirements, Operational and "Human Scale" Applications Stakeholder (NOAA, USDA, Water Resource Agencies, etc.) Requirements are Driving the Need for Better Precipitation Estimates

Straw Man Operational Precipitation Requirements

Application	Timeliness (measurement to user)	Temporal Resolution	Spatial Resolution	Spatial Domain
Flash Floods	$\leq$5 min	$\leq$15 min	$\leq$4 km	CONUS/Land
TRAP	0.5 – 1.5 hr	1-3 hr	$\leq$15 km	Global
Rainfall potential	0.5 – 1.5 hr	1-3 hr	$\leq$15 km	Global
NWP Assimilation	0.5 – 1.5 hr	1-3 hr	$\leq$15 km	Regional & global
Solid Precipitation	0.5 – 1.5 hr	1-3 hr	$\leq$15 km	Regional & global
Climate Monitoring	Daily	3 hr	$\leq$25 km	Global
Soil moisture and wetness	Daily	12 hr	$\leq$25 km	Regional & global land

Applying NASA’s system engineering approach and ESE results to support decision-making tools, predictions, and analysis for policy and management decisions.



Scientific Challenges for GPM Mission

GPM

1. Shift *intellectual inquiry paradigm* from "curiosity driven" to "quintessential problem driven" -- through GPM science team working group coordination.
2. Shift *research paradigm* from "measuring takes precedent" to "prediction takes precedent" -- through mandate for GPM science team.
3. Shift *derived products paradigm* (e.g., latent heating, DSDs, macro/microphysical cloud properties, error characterization, solid precipitation, vertical rain mass flux) from "cautious release" to "aggressive release" -- through modeler involvement in product assessment.
4. Shift *fast delivery data paradigm* from "only operational users need them" to "research users need them too" -- through transfer of specialized data products from GPM-WPDC to research partners conducting prediction experiments.
5. Shift *validation paradigm* from "comparison scatter diagrams" to "physical error modeling" involving inverting flow of data from & to validation center and deploying new ground instruments at various validation supersites.
6. Shift *cloud/precipitation paradigm* from "these are separate & distinct problems" to "this is microphysical continuum" leading to integrated cloud-precipitation missions, research programs, textbooks, and teaching.

Conclusions

GPM

1. Global measurement coverage in conjunction with greater emphasis on spatial resolution & microphysical processes in retrieval will provide framework for implementing GPM research program focused on relationship between global water cycle & global climate variability.
2. Aggressive error reduction - error characterization validation program will provide quantitative conditional bias uncertainty/space-time error covariance information needed for objective rainfall data assimilation used in short and medium range weather forecasting.
3. 3-hour sampling & research emphasis on achieving basin/global scale water budget closure will improve accuracy of hydrometeorological prediction models & their application to assessment of fresh water resources, prediction of seasonal flood-drought conditions, & hazardous flood forecasts.
4. Although challenging, GPM mission data should reveal accelerations in global & regional water cycles -- if data time series are extended to decadal time scale, measurements become microphysics-centric, & research emphasis is given to closure of time derivative form of water budget.